

# VAX



The VAX-11/780 System

digital



## A Perspective - VAX-11/780

PDP-1

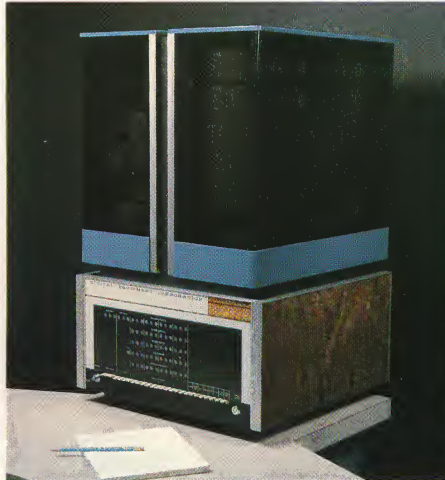


Over the last two decades, Digital Equipment Corporation has set several significant milestones in the computer industry.

Our development of the first small *interactive* computer, the PDP-1, was one of the early milestones. That was in 1959. Later, in 1965, we started a new trend in computing by introducing the first *minicomputer*, the PDP-8. And still later, our PDP-11 16-bit machine, introduced in 1970, innovatively used *large machine architecture in a small computer*—for yet another major contribution.

Before these developments, computers had been large, complex, expensive, unapproachable. Digital's computers were just the opposite. As a result, computer system design gradually took a new turn, and today's shift to interactive and distributed computing began.

PDP-8



Most recently, Digital set another milestone in the computer industry by introducing a new architecture, the VAX 32-bit virtual memory architecture, and the first member of a new family, the VAX-11/780.

Digital's years of computing experience are evident throughout the entire VAX design. Software engineers influenced VAX hardware planning. Hardware engineers contributed to the VAX/VMS software system. The result is a harmonious balance of high-performance convenience and flexibility.

The VAX architecture accommodates extremely large programs, many users, heavy computational loads, and high input/output traffic—all the features you would expect from a high-performance, multi-programming system. Yet VAX continues the PDP-11 tradition of price/performance advantages and engineering ingenuity.

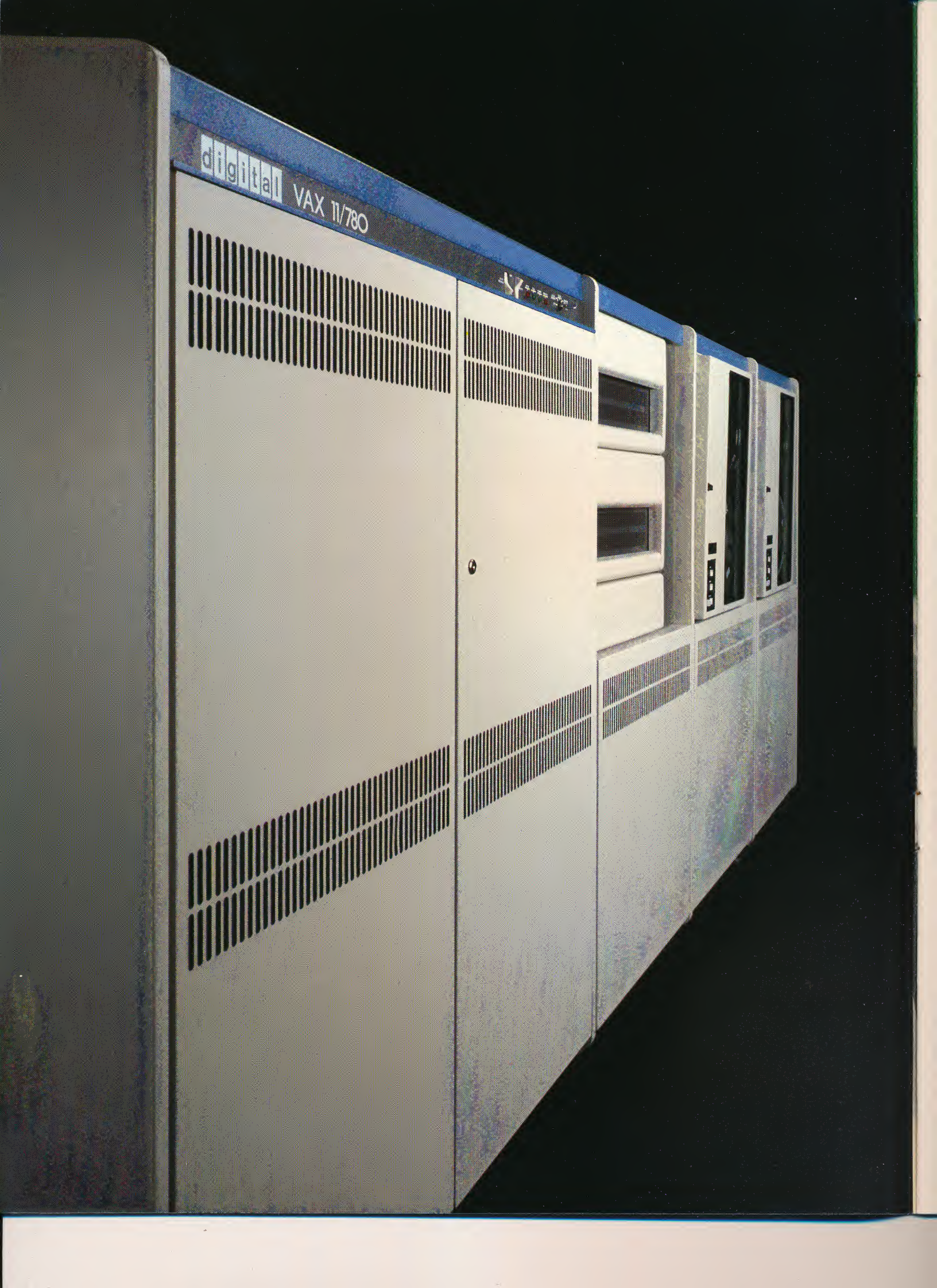
PDP-11



The VAX-11/780, our first 32-bit virtual memory computer, provides the performance features of a truly large-scale machine, but at the price tag of a mini. It is a highly reliable, easily maintained, and readily approachable computer. It is an exceptionally powerful interactive system from the company that made interactive computing practical and cost-effective.

The VAX-11/780 can handle very demanding applications for much less than you'd expect to pay. Yet its high degree of user convenience and versatility are much more than you'd expect from a computer system many times its price.







# The VAX-11/780 At A Glance

## The VAX-11/780 Is a Full 32-Bit Machine With Large Addressing Space

The VAX-11/780 employs a 32-bit architecture. That means 32-bit addressing space for very large programs; 32-bit instructions allowing a variable number of operands; 32-bit bus structures for especially high throughput. It means VAX users can run very large programs, or many large programs at once.

## The VAX-11/780 Has a Rich and Powerful Instruction Set

The richness of the VAX instruction set enables high-level language processors to produce exceptionally efficient compiled code. In fact, many of the VAX instructions are designed specifically to produce compact machine code for entire high-level language routines. In addition, VAX instructions can handle integer, floating point, packed decimal, character string and bit field data types, for outstanding performance in all application areas.

## The VAX-11/780 Has an Advanced Virtual Memory Operating System

The VAX/VMS virtual memory operating system is one of the most powerful and capable operating systems available today. Not only does it adapt—with ease—to changing and demanding user environments, it supports an impressive array of programming languages, data management software, and supporting utilities. These make system operation and application development work easier for sophisticated and novice users alike.

Because VAX's virtual memory system provides up to four billion bytes of virtual addressing, programmers can concentrate on solving the application problem at hand; they do not have to worry about tailoring their solution around the addressing limitations, memory constraints, or overlay restrictions indicative of small computers. Yet, for all this convenience, the VAX/VMS virtual memory operating system puts the emphasis on efficiency.

## The VAX-11/780 Has High Throughput, In Computation and Input/Output Operations

For years users have equated high throughput—the ability to handle large volumes of work quickly—with very large, very expensive computer systems.

VAX puts an end to this misconception. Data and address caching give the VAX-11/780 high computation throughput, producing an effective memory access time of 280 nanoseconds. With its advanced bus structure, the VAX-11/780 supports high I/O throughput. Its maximum aggregate transfer rate of 13.3 megabytes per second satisfies the requirements of even the most sophisticated real-time applications.

## The VAX-11/780 Has Extensive Reliability, Availability and Maintainability Features

The VAX-11/780 gives you performance and capacity. But there's more to the system than that. We've built the latest in error detection, diagnostic and maintenance technology into the architecture to make the system consistently productive. Advanced features include a console diagnostic processor, error correcting memory, remote diagnosis, modular design, and more.

## The VAX-11/780 Has Compatibility With Digital's PDP-11s

Advanced as it is in design, the VAX-11/780 has considerable compatibility with the 130,000 PDP-11s already in use worldwide. We've developed a 32-bit architecture that goes a long way toward preserving our customer's investment in Digital's 16-bit computers.

Consider hardware compatibility. A VAX computer has two categories of instructions: its native 32-bit instructions and PDP-11 compatible 16-bit instructions. Thus, the system can execute VAX programs and PDP-11 programs concurrently.



VAX native mode instructions look very much like PDP-11 instructions. In fact, the similarities are so strong that programmers familiar with the PDP-11 learn to write VAX code in a matter of days.

Consider software compatibility. Several PDP-11 high level language compilers and program development utilities execute on VAX. The VAX/VMS operating system also uses the same file system and access method that most PDP-11 systems do. And it uses the same Digital Command Language.

## The VAX-11/780 Is Easy to Operate, Easy to Control

The VAX-11/780 comes from Digital, the world's leading manufacturer of interactive computer systems. Our experience in computer design becomes apparent as soon as you log on to the system. All system and programming operations reflect a human-engineered command environment that utilizes field-proven interactive dialogues.

A VAX system is designed to operate with a minimum of supervision, in some cases even unattended. But a system manager can always monitor system usage completely through a series of access and privilege files, accounting and system utilities.

*The VAX-11/780 gives you the performance, convenience, and control features of a large system at minicomputer prices.*



# Heavyweight Power for the Jobs That Demand It

What is the significance of 32-bit architecture? Consider that most minicomputers are built to deal with 16 bits of information at a time. That's fine for many of the things people use computers for. But 16-bit architecture has limitations if you want to write especially large programs or manipulate large arrays of data, as is often the case in scientific applications, engineering computation problem solving, simulations, and business data processing.

The VAX-11/780 is free of program size limitations. Its combination of a 32-bit address space plus the conveniences of virtual memory operation frees programmers from the task of breaking up a large program so that it will fit within the boundaries of a small computer's addressing range.

Additionally, since a virtual memory system automatically shuttles portions of a large program in and out of physical memory as those portions are required for execution, it can easily schedule a number of such programs to run at once.

So your benefits are two. If you have large, complex programs, you don't have to buy a large, complex computer to execute them. If you generally run many small programs, but occasionally must execute some very large ones, the VAX-11/780 can handle the entire load concurrently and efficiently.



*The VAX-11/780 can easily handle very large programs, and many programs at once.*



# An Instruction Set That's Economical With Memory

32-bit addressing is only part of the VAX performance story. The architecture has a particularly rich instruction set.

The richness of the VAX instruction set means that high-level language compilers generate more compact and efficient programs; programs execute faster; switching between jobs is faster; mathematical functions are faster and more precise. It also means that programmers can write program code more quickly.

We designed the instruction set after close study of the strengths and weaknesses of other computer systems' instruction sets. In particular, we took the best features of our PDP-11 set and built from there.

For example, whenever we found a programming construct that is a predictable and common part of programming work, we built it into the instruction set. This makes sense since hardware logic is a lot less expensive over the long run than programmer time.

Consider the CALL instruction. Our research found that computers typically spend a great deal of time preparing for subroutine calls and returns. We studied the calling sequences of various programming languages to find out what happens each time. Then we wrote a CALL that does in one instruction what other computers require 10-15 instructions to do. And the standard VAX CALL sequence is used throughout the system by all compilers and system services, so a program written in one language can use a routine written in another.

Each VAX instruction can use any of nine different addressing modes, which means smaller programs and simpler assembly language coding. Instructions are variable length, which means that memory space for them need not be allotted on word boundaries, but on smaller byte boundaries. The advantage is that instructions and data take up much less space in physical memory.

Many VAX instructions can accommodate three operands (arguments), which means that one instruction can perform an operation on two arguments and store the result in the third. Note that VAX does this in *one* instruction, not two or three. This is another way the VAX-11/780 makes compiled programs smaller and faster.

Some of the other constructs which have become single VAX instructions include the FORTRAN computed GOTO statement (the CASE instruction) and the FORTRAN DO loop statement (the ADD, COMPARE, and BRANCH instruction). It shouldn't come as any surprise that the VAX-11/780 has extremely fast FORTRAN capabilities.

But the VAX-11/780 is at home in the commercial world, too. Full decimal arithmetic and text string manipulation are part of its instruction set. For example, business programs which perform alphanumeric searches or create formatted numeric output are greatly optimized by the hardware character string and EDIT instructions. Computer systems without these features have to depend on slower software routines. VAX doesn't.

There's also a built-in floating point instruction set that handles single and double precision (32- and 64-bit) computation; it includes special data types to handle magnitude and precision. An optional fast floating point accelerator adds even more floating point performance, yet is transparent to application programs.

Because the VAX instruction set has these features, your programs are likely to be smaller and to run faster.

We came up with more than efficient instructions, though. While the CPU is executing the current instruction, it also fetches and decodes the next instruction, just to keep a step ahead.



*The VAX instruction set makes compiled programs smaller and faster, so you get more done in less time.*



# A Powerful Virtual Memory Operating System That's As Flexible As Your Job Mix, As Rigid As Control Demands

VAX/VMS, VAX's Virtual Memory operating System, can handle a mix of interactive timesharing and data processing operations, real-time and batch applications, along with simultaneous on-line program development and data management. Its multi-purpose capabilities match the way powerful interactive computers are used today.

Virtual memory was long considered a luxury feature suitable for only very large, very expensive computers. VAX proves this isn't so. In fact, on VAX, virtual memory provides the very foundation for operating system performance.

It's clear that programs residing mostly—or entirely—in physical memory run fastest. Most virtual memory operating systems bring one page of program information into memory at a time, which means lots of disk accesses. But VAX/VMS minimizes disk I/O by bringing clusters of pages—perhaps an entire program—in at a time and then keeping them there as long as they are needed. For high-performance applications, the system manager and the programmer together can determine how many pages should be brought into memory and how long they should reside there, according to the requirements of the application. This gives the system manager control over what's going on system-wide and prevents any single user from monopolizing system resources.

VAX/VMS, like the processor it works with, is designed for performance at every turn.

## Scheduling

One reason VAX/VMS responds so quickly to real-time events lies with its scheduler, which can switch from one job to the next with maximum efficiency. It takes only one instruction to save job context (*all* the information needed by the operating system to reschedule a task), and another instruction to ready the system for the new task. This means very fast context switching between two programs.

The VAX/VMS scheduler always selects the highest priority job that is in main memory and ready to execute. It takes only one instruction to determine which job is next in line.

There are 32 levels of job priority on VAX. In a timesharing environment, the scheduler constantly adjusts job priorities to achieve the best mix of compute-heavy and I/O-heavy jobs.

In a real-time environment, the system manager grants privileges to users to control job scheduling. Programs are set to execute at specified time intervals, in response to external events, or at fixed priorities. In addition, the system manager (or the user granted the appropriate privilege) can lock a program, or parts of the program, in memory to guarantee the fastest possible response. With these features, the system manager can make sure that less important jobs don't hold up more important ones.

VAX/VMS gives you all this performance while delivering the user conveniences and system management controls you'd expect only in a much larger, more complex system.

## Programming Languages

Your programmers can work in any of several programming languages. VAX-11 FORTRAN is an especially complete version of the leading language for scientific and engineering computation. It is a high performance superset of the American National Standard Institute's (ANSI) 1966 FORTRAN, and also implements the features of the ANSI-77 standard.

FORTRAN supports character data types, an IF-THEN-ELSE statement, long variable names, and the standard system CALL facility for calling system services.

VAX-11 COBOL, the familiar business programming language, conforms to the ANSI-74 specifications regarding language element, representation, symbology, and coding formats.

COBOL provides the high performance that is characteristic of all VAX languages. It supports sequential, relative, and indexed file organizations; COBOL standard data types including packed decimal; and, via the standard CALL facility, direct calls to VAX/VMS system services and external routines.

Commercial and timesharing users are pleased to find the familiar BASIC programming language on VAX—our BASIC extends many of the features found in industry versions.

BLISS-32 is VAX's high-level systems implementation language, designed to simplify development of operating system software and compilers.

While a high-level language, BLISS-32 provides assembly language capabilities. For example, BLISS programmers can directly reference memory addresses and general-purpose registers; use macros, library facilities, and compile-time facilities; and select among several data structures. In fact, programmers often choose to use BLISS when before they would have relied on assembly language. They find BLISS coding faster, program maintenance far easier, and program compilation extremely efficient.

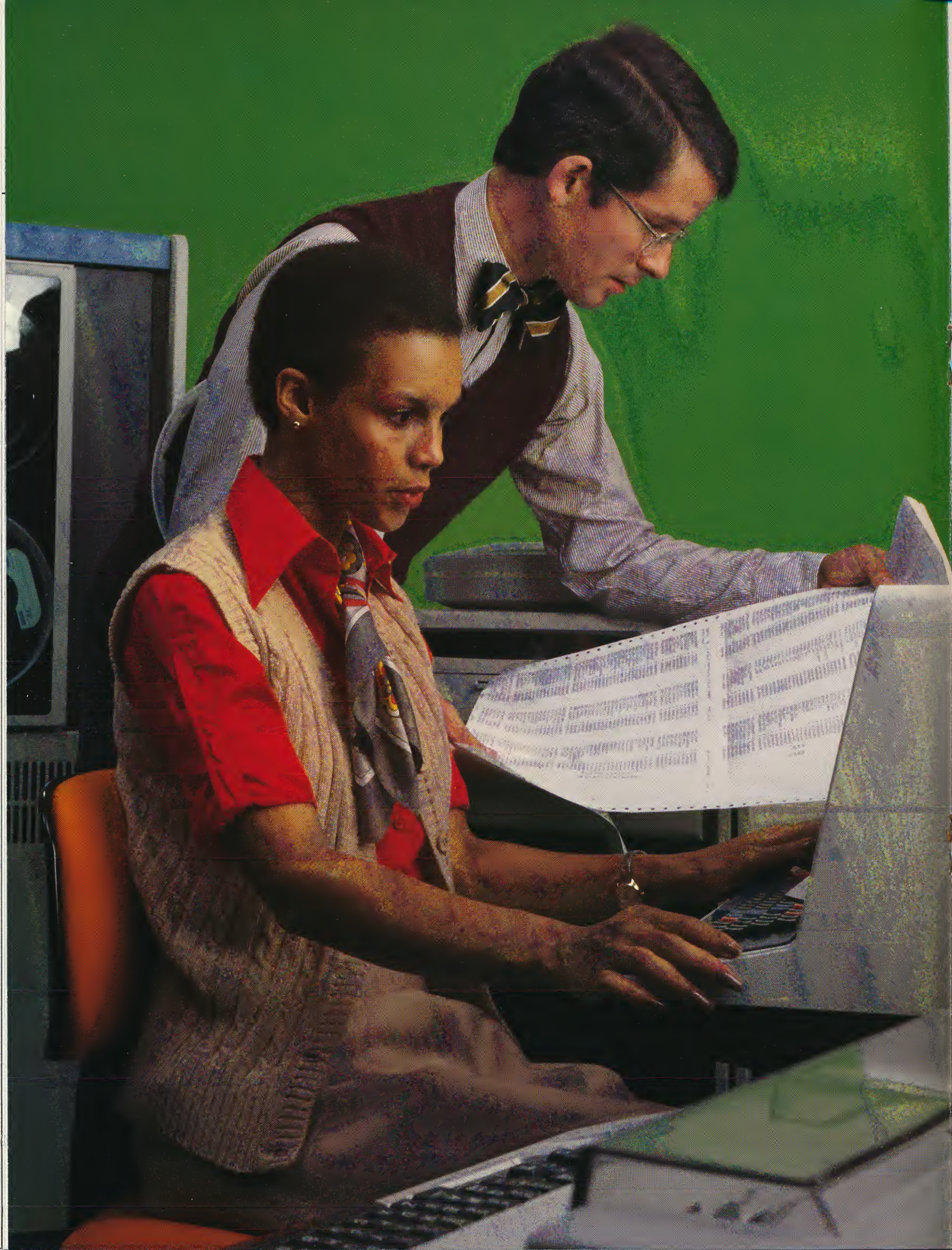
For those who prefer to use assembly language, VAX's MACRO assembler supports over 240 machine-level instructions for precise and efficient coding. And because the 32-bit assembly language is so similar to that used by all PDP-11s, programmers already familiar with Digital's 16-bit assembly language can make the transition to VAX quite easily.

*The VAX-11/780's power results from the harmony of its overall design. High performance marks every crucial element of the system.*











VAX/VMS also supports PASCAL. Because of its emphasis on structured programming techniques, PASCAL is now taught by many educational institutions to students as their first programming language. The VAX version extends the defined standard, and provides a stepping-stone to users who are becoming familiar with VAX programming aids.

Finally, CORAL-66, an accepted British government standard programming language, is supported by VAX for real-time and process control applications.

### Interactive Program Debugging

One of VAX/VMS's most helpful program development aids is its interactive symbolic debugging utility, DEBUG. DEBUG lets programmers step through application programs, interactively and logically, controlling execution at the terminal. They can use symbolic references and address names just as they appear in the source code. Interactive symbolic debugging greatly simplifies logic checking and program reliability, and speeds the entire development cycle.

### Command Language

VAX users work with the Digital standard interactive Command Language (DCL), a set of command statements typed to initiate and control system operations. DCL makes it easy for new users to become acquainted with the system because it prompts for the information it needs. The command language also provides a "help" facility for users who are unfamiliar with command formats. In addition, users may define commands for general-purpose procedures.

### Batch Facilities

VAX/VMS offers an excellent multi-stream batch facility that uses the same command language available to the interactive user. Users can control the flow of batch jobs by specifying what error conditions will cause the job to stop, and by suspending execution so that the operator can load a device. Users can also specify a time of day at which a batch job will execute.

Input and output for record-oriented devices, such as card readers and printers, are queued to disk and controlled by system spoolers. The operator has full control over the number of batch and spooler queues and can dynamically modify these services to meet changing system requirements.

### Data and File Management

VAX's data management services help you manage and work with the information in your computer system. A set of general-purpose software lets application programs create, access, and maintain records and files. The set includes utilities for moving records to and from user programs.

VAX's data management system gives you a choice of relative, sequential, and indexed sequential file organizations, and permits as many as 255 identifying keys for each record in an indexed file.

In addition to special utilities, several access methods provide a great deal of flexibility for organizing and maintaining data records. Record locking prevents users from updating the same relative or indexed record at the same time.

A SORT utility allows record re-ordering and reformatting of sequential, relative, and indexed data files, using a variety of sorting techniques.

For data reporting, the DATATRIEVE utility provides fast on-line access to the records in files. Simple commands support data inquiry, updating, and reporting operations and allows users at any terminal to interactively use the data in files.

The VAX/VMS internal on-disk file structure facilitates the creation, extension, and deletion of files. The system allows the owner of a file to deny all access or certain kinds of access to all users, groups of users, or particular users sharing a system. And it allows files to be stored across volumes for greater application flexibility.

### Intersystem Connections

VAX systems can be physically connected to other VAX systems, to other Digital systems, and to other computer systems, through a variety of communications interfaces.

DECnet is Digital's own networking software that sets up a VAX system in a computer network and simplifies applications programming and network management.

DECnet equips a VAX-11/780 system for point-to-point communications over synchronous lines. It provides the system with network transparency, which means it removes most of the burden of data communications programming.

DECnet lets a VAX user transfer files to or delete them from other VAX systems in the network, or from any other Digital system that supports the current DECnet protocols. DECnet also allows a system to read and write records within other computers' files, and to download to PDP-11s running the RSX-11S real-time operating system.

A high-speed parallel communications link is also available to connect VAX and/or PDP-11 computers in a local network. The network can include as many as 16 processors and allows direct communications among all.

Communication is possible between VAX systems and those supported by other vendors, IBM and CDC systems, for example. Compatible communication utilities let users transfer and receive files between systems, and send and receive batch processing jobs.

VAX systems can also communicate through shared memory. The MA780 memory interface allows as many as four VAX-11/780 systems to share up to four megabytes of multi-ported memory (in addition to each system's local memory component). VAX systems can thus be configured using shared memory to pool processing power for extremely high throughput or to increase overall system availability to meet the requirements of a variety of applications.







# The VAX-11/780 Gets the Work Out - Quickly

The VAX instruction set and addressing modes make a major contribution to system throughput, but there are several other design elements that contribute to high performance.

The VAX-11/780 processor has sixteen 32-bit general-purpose registers for fast data manipulation. These registers can serve as temporary storage, as accumulators, index registers, and base registers.

The system's MOS (Metal Oxide Semiconductor) main memory has a fast 600 nanosecond access time, and a data cache lowers this to a very fast 280 nanoseconds. An instruction cache lets the CPU fetch and decode the next instruction even as the current one executes. An address cache eliminates extra memory accesses during translation from virtual to physical memory addresses.

Besides being fast, VAX memory has built-in error checking and correcting (ECC) code. VAX currently supports up to eight megabytes of this memory, which provides greater performance than core memory, draws less electrical power, and offers more compact size, better reliability, and lower maintenance costs.

I/O capability is right in step with the CPU's processing power. The internal data paths and I/O structure are well adapted for running large programs or many programs, for superior data handling, and for rapid communication between I/O devices and the CPU.

The heart of the I/O capability is a 32-bit wide data and control path that transmits bursts of data or control information every 200 nanoseconds. It moves as many as 13.3 megabytes of data per second among the system's major hardware components.

Two types of external buses—the MASSBUS and the PDP-11 UNIBUS complete the link between the VAX-11/780's high-speed central bus and disks and other peripherals. As many as four of each type (MASSBUS and UNIBUS) can be connected per system: general-purpose and customer-developed devices tie in through a UNIBUS; high performance disk drives and other mass storage devices use a MASSBUS.



# The VAX-11/780 Is Designed To Keep You In Business

The VAX-11/780 is as notable for dependability as it is for performance, convenience, and support. A high level of uptime, fewer data errors, and lower maintenance costs were very important goals in the system design. It's another way the VAX-11/780 matches the contemporary user's idea of what a computer system should be.

## Carefully Designed Packaging

We started with the VAX-11/780 cabinet, which meets Underwriters Laboratories requirements. The cabinet has been designed to conform with the I.E.C. 435 standard, widely used in Europe, as well.

The cabinet has especially large and powerful cooling blowers to eliminate any heat pockets. Sensors detect power loss, excessive temperature, and under-airflow conditions to guard the system from damage. The cabling is carefully arranged in troughs where it is well protected and doesn't interfere with airflow.

The VAX-11/780 uses the same TTL technology that's proven itself in our highly reliable PDP-11/70. Component derating adds an extra margin of reliability—components are designed to handle loads way beyond those required by normal processing.

## Continuous Reliability Checking

The care in packaging protects major hardware elements. Continual checking by the hardware (and uniform exception handling by the software) protects reliability of the data moving through the system.

VAX/VMS performs parity checks on most major hardware components and provides its own set of error checks.

And if you have a critical disk file, the VAX-11/780 lets you do a write/verify operation to confirm that the transfer occurred correctly.

## A High Availability System

Reliability is only part of the story, however. The VAX-11/780 has numerous features that contribute directly

to system availability—the amount of time a computer is available for use. A VAX system can continue to provide user services under conditions that would bring other computer systems down, or at least curtail their service.

Many computer systems can't run user jobs and maintenance operations simultaneously. The VAX-11/780 can. Many of the VAX hardware diagnostics run concurrently with normal processing.

When individual components are down for servicing, the VAX-11/780 doesn't have to stop. You can power down most MASSBUS peripherals on-line, for instance. Even if cache memory and the floating point accelerator are disabled, the system can continue to run.

The VAX-11/780 is minimally dependent on any particular physical memory or system devices for startup. The system bypasses devices that aren't working, even sections of memory, whenever possible. Bad disk blocks are similarly bypassed. And on-line error logging monitors and notes such occurrences so that you can have a record for later maintenance.

Automatic restart capabilities avoid the time-consuming shutdown most computers require after a power fail or crash. Optional battery backup protects the contents of MOS memory from transient or intermittent power failure.

## Fast and Easy System Maintenance

Along with reliability and availability, the VAX-11/780 provides maintainability—fast, low cost problem correction.

For example, Digital sends out VAX/VMS software and related product updates and corrections on flexible disks. Our VAX/VMS alternative to typing in laborious patches by hand, this not only saves time, but means you don't have to rely on an operator to type in all the information correctly.

On the hardware side, a great deal of design attention went to accessibility of the system's components. Our technicians can get at things easily, without disassembling other things. Power supplies, for example, are self-checking, modular, and easily replaceable.

VAX/VMS software logs all hardware errors. There is extensive parity checking on internal buses and registers. Numerous maintenance devices within the processor monitor and record error conditions. Other maintenance devices simulate error conditions to check that these watchdogs are working.

System and bus error logging and improved diagnostic aids help field technicians locate and identify error conditions quickly and verify a fault-free system.

VAX diagnostic tests isolate faults efficiently and in a short time. The system's diagnostic console provides a human-oriented interface; the operator exercises and monitors the tests at a terminal, not with lights and switches. There are diagnostics for the CPU and microprocessor, peripheral diagnostics, system diagnostics, and fault insertion tests of the diagnostics themselves.

The User Environmental Test Package is an example of these comprehensive tests. The UETP is a series of diagnostics used by Digital's field service organization both to verify system components after installation and to demonstrate system operation. UETP diagnostics are available for VAX customers to use, too.

Finally, the VAX-11/780 supports remote diagnostics, which allow you to share the results of system diagnostic routines with highly-skilled troubleshooters at a central Digital Diagnosis Center. Remote diagnosis lets Digital pinpoint the problem shortly after you report it. When our service specialists arrive at your door, they'll already know what the problem is and be prepared to correct it.

*The VAX-11/780 doesn't have to stop when individual components are down for servicing. And that's only one of the reasons why the VAX-11/780 is an exceptionally dependable computer system.*







# Choose The VAX-11/780 System That Fits You Best



The VAX-11/780 comes in a series of packaged systems. Each contains a basic VAX-11/780 processor, intelligent diagnostic console, interval and time of year clocks, 8K byte cache, the VAX/VMS operating system, and a mass storage system based on selected combinations of disks and magtapes.

Each packaged system is complete and ready-to-run. However, you can add components whenever you wish: processor options, such as a floating point accelerator; software options; extra MOS memory up to eight megabytes; multiport memory up to four megabytes; and as many as three additional MASSBUS and three additional UNIBUS bus systems.

The choice of peripherals includes a wide range of small and large capacity disk drives, magnetic tape systems, real-time interfaces, hard copy and video display terminals, line printers and card readers.

Software options include a variety of programming languages, communications packages, and application specific software.

The following chart provides a more comprehensive list.



## VAX-11/780 Components and Options

### Processor Options

- High-Performance Floating Point Accelerator
- 12KB Writable Control Store and Tools
- MOS memory (up to 8MB in units of 256KB, 512KB, 1MB and 2MB)
- MOS Multiport Memory (up to 4MB in units of 256KB)
- MOS Memory Battery Backup (4MB for up to 10 minutes)

### Input/Output Options

- Cartridge Disks (28MB, 14MB)
- High-Speed, Large Capacity Disks (67MB, 176MB)
- Magnetic Tapes (800 or 1600 bpi, 9-track: 45 ips, 75 ips, 125 ips)
- Asynchronous Terminal Multiplexers (8 and 16 line units)
- Synchronous Communications Interface (Local and Remote Network Links)
- High-Speed Direct Memory Access Interfaces
- High-Speed Direct Memory Access Controller for Laboratory I/O Devices
- Laboratory Peripheral Options
- High-Speed Multiple Computer Communications Link (Local)
- Line Printers (132 column; variety of print speeds)
- Printer/Plotter (Remote and Local)
- Card Readers (300 cpm, 600 cpm)
- Terminals (Console and Desk Top; Hard Copy and Video Display)

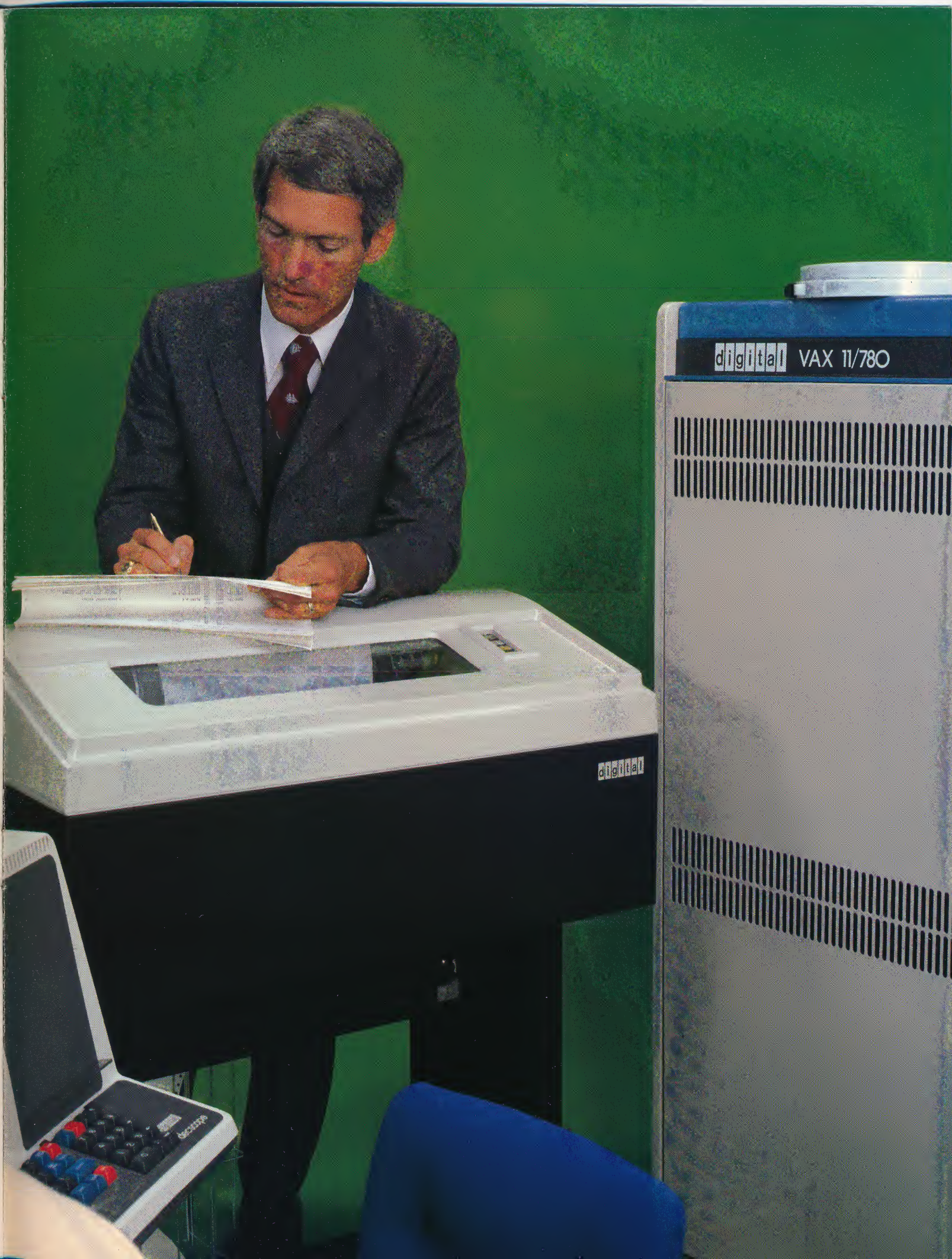


## Software Products

- VAX/VMS Virtual Memory Operating System
- Programming Languages (FORTRAN, COBOL, BASIC, BLISS-32, PASCAL, MACRO, CORAL-66, RPG II)
- Communications Packages (DECnet, MUX200, 2780/3780)
- Reporting And Inquiry Language (DATATRIEVE)
- Word Processing Software (DX/VMS)
- Engineering Design Utilities
- Extensive Documentation

*The VAX-11/780 has the power and features users want, at an affordable price.*







# Digital's Services Match Your Needs, Your Budget, And Your Skills

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The quality of products is important, but the quality of the organization behind them is crucial. Digital's success is due to the services it offers its customers, as well as to its exceptional products.

## Hardware Maintenance Services

Digital has systems-trained service representatives and spare parts depots in over 350 locations worldwide. From these locations, more than 8000 service representatives provide customers with the best computer maintenance service available anywhere.

Digital's primary service offering is DECservice, designed for the customer whose applications require uninterrupted operation. The DECservice Agreement offers a defined response time of four hours, and further provides that, once on site, Digital will work continuously until the system is returned to operating condition.

For those customers who may not need fixed response time and continuous maintenance effort, Digital Field Service offers the Basic Service Agreement. This agreement provides priority response, scheduled preventive maintenance, all parts and labor, and the administration and installation of engineering change orders.

DECservice and Basic Service are available from eight hours, five days per week, to 24 hours, seven days per week. Both contracts include remote diagnosis for selected systems.

Digital also offers on-site service on an as-needed time and materials basis. Off-site service is available for customers who have the expertise to perform their own maintenance.

## Software Services

Digital's software support personnel are professionals specifically trained in Digital's products. They are ready to assist you whenever you need help, with services ranging from telephone consultation to customized software installation and support.

Software consultants are experienced in designing, coding, or modifying customer software to meet specific needs. Consulting services are available on a time-and-materials basis for a short term (per-call), or a longer term (monthly or resident).

Software Products Services provide continuing support beyond warranty for customers' software systems. Several levels of service are available on either a monthly or annual basis. VAX/VMS Binary Program Update Service provides automatic updates of new releases as they become available, a product-related periodical, and Software Performance Reporting services. VAX/VMS Basic Service for Software includes all the components of the Binary Program Update Service, and also provides fast-response, toll-free telephone assistance. The most comprehensive service, DECsupport, includes all these services, plus installation of updates and Program Change Orders as needed, and on-site support when problems cannot be solved over the telephone.

## Computer Special Systems

Computer Special Systems (CSS) develops any kind of customer hardware or software, or a complete turn-key solution. This includes special interfaces and high-performance peripherals.

## Educational Services

Formal training is available to all Digital customers. A full-time staff of professional instructors conducts regularly scheduled courses at Educational Centers located around the world. The curriculum consists of complete courses in hardware and software, from basic concepts to the most complex. The VAX/VMS curriculum, for example, ranges from a course that introduces the VAX system to one that instructs users on how to write I/O device drivers. By special arrangement, courses can be designed to meet specific user requirements and can also be presented at a customer's site.

## DECUS

The Digital Equipment Computer Users Society, DECUS, is an international nonprofit organization supported in part by Digital, but controlled by users who own or who use a Digital computer. Organized for the exchange of information and the discussion of common problems, DECUS sponsors local, national, and international meetings, as well as a periodic newsletter. DECUS also maintains an extensive library of member-contributed programs, all of which are available to other members upon request.



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